

Appendix 5

Fluvial Geomorphological Detailed Information

Date: 03-Jun-08

Site:

VG-R2

Crew:

JS

Location:

Richmond, Ottawa

Weather Description: rain

Recorder: JS

FORM / PROCESS	GEOMORPHIC INDICATOR		PRESENT? (✓)		FACTOR VALUE
	Num	Description	No	Yes	
Evidence of Aggradation (AI)	1	Lobate Bar	X		
	2	Coarse materials in riffles embedded	X		
	3	Siltation in pools	X		
	4	Medial bars	X		
	5	Accretion on point bars	X		
	6	Poor longitudinal sorting of bed materials		X	
	7	Deposition in the overbank zone	X		
Sum of Indices:			6	1	0.14
Evidence of Degradation (DI)	1	Exposed bridge footing(s)	NA		
	2	Exposed sanitary / storm sewer / pipeline / etc.	X		
	3	Elevated storm sewer outfall(s)		X	
	4	Undermined gabion baskets / concrete aprons / etc.		X	
	5	Scour pools d/s of culverts / storm sewer outlets		X	
	6	Cut face on bar forms	X		
	7	Head cutting due to knick point migration	X		
	8	Terrace cut through older bar material	X		
	9	Suspended armour layer visible in bank	X		
	10	Channel worn into undisturbed overburden / bedrock		X	
Sum of Indices:			5	4	0.44
Evidence of Widening (WI)	1	Fallen / leaning trees / fence posts / etc.		X	
	2	Occurrence of large organic debris		X	
	3	Exposed tree roots		X	
	4	Basal scour on inside meander bends	X		
	5	Basal scour on both sides of channel through riffle	X		
	6	Gabion baskets / concrete walls / etc. out flanked	X		
	7	Length of basal scour >50% through subject reach	X		
	8	Exposed length of previously buried pipe / cable / etc.	X		
	9	Fracture lines along top of bank	X		
	10	Exposed building foundation	NA		
Sum of Indices:			6	3	0.33
Evidence of Planimetric Form Adjustment (PI)	1	Formation of chute(s)		X	
	2	Single thread channel to multiple channel	X		
	3	Evolution of pool-riffle form to low bed relief form		X	
	4	Cut-off channel(s)	X		
	5	Formation of island(s)	X		
	6	Thalweg alignment out of phase meander form	X		
	7	Bar forms poorly formed / reworked / removed		X	
Sum of Indices:			4	3	0.43

COMMENTS:

STABILITY INDEX:

0.34

Condition:

Tranistional

~ Factor Value = # YES / Total #

~ STABILITY INDEX (SI) = (AI+DI+WI+PI)/4

SI ≤ 0.20 = In Regime

SI 0.21 - 0.40 = Transitional or Stressed

SI ≥ 0.41 = In Adjustment

Date: 03-Jun-08

Site: VG-R2

Crew: JS

Location:

Richmond, ON

Weather Description:

rain, clouds

Recorder:

JS

	<i>Excellent</i>	<i>Good</i>	<i>Fair</i>	<i>Poor</i>	<i>Points</i>
Channel Stability	9 - 11	6 - 8	3 - 5	0 - 2	4
Scour / Deposition	7 - 8	5 - 6	3 - 4	0 - 2	2
Instream Habitat	7 - 8	5 - 6	3 - 4	0 - 2	3
Water Quality	7 - 8	5 - 6	3 - 4	0 - 2	2
Riparian Conditions	6 - 7	4 - 5	2 - 3	0 - 2	4
Biological Indicators	7 - 8	5 - 6	3 - 4	0 - 2	2
Total:					17

Stability Rankings:

<20 = *LOW*

20 - 35 = *MODERATE*

>35 = *HIGH*

Channel Dimensions (Measured / Estimated)

Bankfull Width (m) 4, 6, 4.5, 9, 5, 10

Bankfull Depth (m) 0.6, 1.2, 1, 1.5

Wetted Width (m) 3.5, 4, 5, 7

Wetted Depth (m) 0.2, 0.3, 0.5, 0.4, 1

Gradient low-moderate

Entrenchment (m) low

Substrate (Pool) sand/clay

Substrate (Riffle) sand/pebbles

Straight / Sinuous low sinuosity

Bend Radius NA

Bank Height (m) 1.5-2 m

Bank Angle (°) 30-50

Bank Material clay/silt

Vegetation grasses, herbs

Pool - Riffle Spacing (m) 5.0-7.0

Woody Debris minor

Channel Hardening rip rap on banks

Channel Disturbance road culverts and farm crossing culverts

Distance Walked all

Photos Taken yes

Comments Some areas had lots of instream vegetation. A few trees on the top of banks.

Date: 03-Jun-08

Site: VG-R2-1

Crew: JS

Location: Richmond, Ottawa

Weather Description: rain

Recorder: JS

FORM / PROCESS	GEOMORPHIC INDICATOR		PRESENT? (✓)		FACTOR VALUE
	Num	Description	No	Yes	
Evidence of Aggradation (AI)	1	Lobate Bar	X		
	2	Coarse materials in riffles embedded	X		
	3	Siltation in pools		X	
	4	Medial bars	X		
	5	Accretion on point bars	X		
	6	Poor longitudinal sorting of bed materials		X	
	7	Deposition in the overbank zone	X		
Sum of Indices:			5	2	0.29
Evidence of Degradation (DI)	1	Exposed bridge footing(s)	NA		
	2	Exposed sanitary / storm sewer / pipeline / etc.	NA		
	3	Elevated storm sewer outfall(s)	NA		
	4	Undermined gabion baskets / concrete aprons / etc.	X		
	5	Scour pools d/s of culverts / storm sewer outlets	NA		
	6	Cut face on bar forms	X		
	7	Head cutting due to knick point migration	X		
	8	Terrace cut through older bar material	X		
	9	Suspended armour layer visible in bank	X		
	10	Channel worn into undisturbed overburden / bedrock	X		
Sum of Indices:			6	0	0
Evidence of Widening (WI)	1	Fallen / leaning trees / fence posts / etc.	X		
	2	Occurrence of large organic debris	X		
	3	Exposed tree roots	X		
	4	Basal scour on inside meander bends	X		
	5	Basal scour on both sides of channel through riffle	X		
	6	Gabion baskets / concrete walls / etc. out flanked	X		
	7	Length of basal scour >50% through subject reach	X		
	8	Exposed length of previously buried pipe / cable / etc.	NA		
	9	Fracture lines along top of bank		X	
	10	Exposed building foundation	NA		
Sum of Indices:			7	1	0.13
Evidence of Planimetric Form Adjustment (PI)	1	Formation of chute(s)	X		
	2	Single thread channel to multiple channel	X		
	3	Evolution of pool-riffle form to low bed relief form	X		
	4	Cut-off channel(s)	X		
	5	Formation of island(s)	X		
	6	Thalweg alignment out of phase meander form	X		
	7	Bar forms poorly formed / reworked / removed		X	
Sum of Indices:			6	1	0.14

COMMENTS:

STABILITY INDEX: 0.14

Condition: In Regime

~ Factor Value = # YES / Total #

~ STABILITY INDEX (SI) = (AI+DI+WI+PI)/4

SI ≤ 0.20 = In Regime

SI 0.21 - 0.40 = Transitional or Stressed

SI ≥ 0.41 = In Adjustment

Date: 03-Jun-08

Site: VG-R2-1

Crew: JS

Location:

Richmond, ON

Weather Description:

rain, clouds

Recorder:

JS

	<i>Excellent</i>	<i>Good</i>	<i>Fair</i>	<i>Poor</i>	<i>Points</i>
Channel Stability	9 - 11	6 - 8	3 - 5	0 - 2	4
Scour / Deposition	7 - 8	5 - 6	3 - 4	0 - 2	2
Instream Habitat	7 - 8	5 - 6	3 - 4	0 - 2	2
Water Quality	7 - 8	5 - 6	3 - 4	0 - 2	2
Riparian Conditions	6 - 7	4 - 5	2 - 3	0 - 2	4
Biological Indicators	7 - 8	5 - 6	3 - 4	0 - 2	2
Total:					16

Stability Rankings:

<20 = LOW

20 - 35 = MODERATE

>35 = HIGH

Channel Dimensions (Measured / Estimated)

Bankfull Width (m)	4-4.5	Bankfull Depth (m)	0.6, 0.8, 1
Wetted Width (m)	2, 2.5, 4	Wetted Depth (m)	0.15, 0.3, 0.4
Gradient	low-moderate	Entrenchment (m)	low-moderate
Substrate (Pool)	NA	Substrate (Riffle)	silt/clay/sand
Straight / Sinuous	very low	Bend Radius	NA
Bank Height (m)	1.5-2 m	Bank Angle (°)	30-50
Bank Material	silt/clay	Vegetation	tall grasses, herbs
Pool - Riffle Spacing (m)	NA	Woody Debris	none
Channel Hardening			rip rap on banks
Channel Disturbance			rip rap
Distance Walked	300 m	Photos Taken	yes

Comments Lots of instream vegetation, moderate flow velocities. No fish observed in the channel.

Date: 03-Jun-08

Site: VG-R2-2

Crew: JS

Location: Richmond, Ottawa

Weather Description: rain

Recorder: JS

FORM / PROCESS	GEOMORPHIC INDICATOR		PRESENT? (✓)		FACTOR VALUE
	Num	Description	No	Yes	
Evidence of Aggradation (AI)	1	Lobate Bar	X		
	2	Coarse materials in riffles embedded	X		
	3	Siltation in pools		X	
	4	Medial bars	X		
	5	Accretion on point bars	X		
	6	Poor longitudinal sorting of bed materials		X	
	7	Deposition in the overbank zone	X		
Sum of Indices:			5	2	0.29
Evidence of Degradation (DI)	1	Exposed bridge footing(s)	NA		
	2	Exposed sanitary / storm sewer / pipeline / etc.	X		
	3	Elevated storm sewer outfall(s)		X	
	4	Undermined gabion baskets / concrete aprons / etc.	X		
	5	Scour pools d/s of culverts / storm sewer outlets	NA		
	6	Cut face on bar forms	X		
	7	Head cutting due to knick point migration	X		
	8	Terrace cut through older bar material	X		
	9	Suspended armour layer visible in bank	X		
	10	Channel worn into undisturbed overburden / bedrock	X		
Sum of Indices:			7	1	0.13
Evidence of Widening (WI)	1	Fallen / leaning trees / fence posts / etc.	X		
	2	Occurrence of large organic debris	X		
	3	Exposed tree roots	X		
	4	Basal scour on inside meander bends	X		
	5	Basal scour on both sides of channel through riffle	X		
	6	Gabion baskets / concrete walls / etc. out flanked	X		
	7	Length of basal scour >50% through subject reach	X		
	8	Exposed length of previously buried pipe / cable / etc.	NA		
	9	Fracture lines along top of bank	X		
	10	Exposed building foundation	NA		
Sum of Indices:			8	0	0
Evidence of Planimetric Form Adjustment (PI)	1	Formation of chute(s)	X		
	2	Single thread channel to multiple channel	X		
	3	Evolution of pool-riffle form to low bed relief form	X		
	4	Cut-off channel(s)	X		
	5	Formation of island(s)	X		
	6	Thalweg alignment out of phase meander form	X		
	7	Bar forms poorly formed / reworked / removed		X	
Sum of Indices:			6	1	0.14

COMMENTS:
STABILITY INDEX: 0.14

Condition: In Regime

~ Factor Value = # YES / Total #

~ STABILITY INDEX (SI) = (AI+DI+WI+PI)/4

SI ≤ 0.20 = In Regime

SI 0.21 - 0.40 = Transitional or Stressed

SI ≥ 0.41 = In Adjustment

Date: 03-Jun-08

Site: VG-R2-2

Crew: JS

Location:

Richmond, ON

Weather Description:

rain, clouds

Recorder:

JS

	<i>Excellent</i>	<i>Good</i>	<i>Fair</i>	<i>Poor</i>	<i>Points</i>
Channel Stability	9 - 11	6 - 8	3 - 5	0 - 2	5
Scour / Deposition	7 - 8	5 - 6	3 - 4	0 - 2	2
Instream Habitat	7 - 8	5 - 6	3 - 4	0 - 2	2
Water Quality	7 - 8	5 - 6	3 - 4	0 - 2	2
Riparian Conditions	6 - 7	4 - 5	2 - 3	0 - 2	4
Biological Indicators	7 - 8	5 - 6	3 - 4	0 - 2	2
Total:					17

Stability Rankings:

<20 = LOW

20 - 35 = MODERATE

>35 = HIGH

Channel Dimensions (Measured / Estimated)

Bankfull Width (m)	2-4	Bankfull Depth (m)	0.7-1.2
Wetted Width (m)	1.5-2.5	Wetted Depth (m)	0.5-0.6
Gradient	low	Entrenchment (m)	low
Substrate (Pool)	NA	Substrate (Riffle)	silt/clay
Straight / Sinuous	straight	Bend Radius	NA
Bank Height (m)	1.5-2 m	Bank Angle (°)	35-55
Bank Material	silt	Vegetation	tall grasses, herbs, shrubs on south side
Pool - Riffle Spacing (m)	NA	Woody Debris	minor
Channel Hardening			rip rap on banks
Channel Disturbance			rip rap
Distance Walked	300 m	Photos Taken	yes

Comments Lots of instream vegetation, very slow flow velocities.

Date: 03-Jun-08

Site:

VG-R3

Crew:

JS

Location:

Richmond, Ottawa

Weather Description: rain

Recorder: JS

FORM / PROCESS	GEOMORPHIC INDICATOR		PRESENT? (✓)		FACTOR VALUE
	Num	Description	No	Yes	
Evidence of Aggradation (AI)	1	Lobate Bar		X	
	2	Coarse materials in riffles embedded	X		
	3	Siltation in pools	X		
	4	Medial bars	X		
	5	Accretion on point bars	X		
	6	Poor longitudinal sorting of bed materials		X	
	7	Deposition in the overbank zone	X		
Sum of Indices:			5	2	0.29
Evidence of Degradation (DI)	1	Exposed bridge footing(s)	X		
	2	Exposed sanitary / storm sewer / pipeline / etc.	X		
	3	Elevated storm sewer outfall(s)		X	
	4	Undermined gabion baskets / concrete aprons / etc.	X		
	5	Scour pools d/s of culverts / storm sewer outlets		X	
	6	Cut face on bar forms	X		
	7	Head cutting due to knick point migration	X		
	8	Terrace cut through older bar material	X		
	9	Suspended armour layer visible in bank	X		
	10	Channel worn into undisturbed overburden / bedrock	X		
Sum of Indices:			8	2	0.2
Evidence of Widening (WI)	1	Fallen / leaning trees / fence posts / etc.		X	
	2	Occurrence of large organic debris		X	
	3	Exposed tree roots		X	
	4	Basal scour on inside meander bends	X		
	5	Basal scour on both sides of channel through riffle	X		
	6	Gabion baskets / concrete walls / etc. out flanked	NA		
	7	Length of basal scour >50% through subject reach	X		
	8	Exposed length of previously buried pipe / cable / etc.	NA		
	9	Fracture lines along top of bank	X		
	10	Exposed building foundation	NA		
Sum of Indices:			4	3	0.43
Evidence of Planimetric Form Adjustment (PI)	1	Formation of chute(s)	X		
	2	Single thread channel to multiple channel		X	
	3	Evolution of pool-riffle form to low bed relief form	X		
	4	Cut-off channel(s)	X		
	5	Formation of island(s)		X	
	6	Thalweg alignment out of phase meander form	X		
	7	Bar forms poorly formed / reworked / removed		X	
Sum of Indices:			4	3	0.43

COMMENTS:

STABILITY INDEX:

0.38

Condition:

Transitional

~ Factor Value = # YES / Total #

~ STABILITY INDEX (SI) = (AI+DI+WI+PI)/4

SI ≤ 0.20 = In Regime

SI 0.21 - 0.40 = Transitional or Stressed

SI ≥ 0.41 = In Adjustment

Date: 03-Jun-08

Site: VG-R3

Crew: JS

Location:

Richmond, ON

Weather Description:

rain, clouds

Recorder:

JS

	Excellent	Good	Fair	Poor	Points
Channel Stability	9 - 11	6 - 8	3 - 5	0 - 2	4
Scour / Deposition	7 - 8	5 - 6	3 - 4	0 - 2	3
Instream Habitat	7 - 8	5 - 6	3 - 4	0 - 2	3
Water Quality	7 - 8	5 - 6	3 - 4	0 - 2	2
Riparian Conditions	6 - 7	4 - 5	2 - 3	0 - 2	5
Biological Indicators	7 - 8	5 - 6	3 - 4	0 - 2	3
Total:					20

Stability Rankings:

<20 = LOW

20 - 35 = MODERATE

>35 = HIGH

Channel Dimensions (Measured / Estimated)

Bankfull Width (m)	4, 6, 4.5, 7	Bankfull Depth (m)	0.6, 0.8-1
Wetted Width (m)	2, 2.5, 3, 4	Wetted Depth (m)	0.15, 0.3, 0.6
Gradient	low	Entrenchment (m)	low, moderate
Substrate (Pool)	NA	Substrate (Riffle)	silt/pebbles/sand
Straight / Sinuous	low	Bend Radius	NA
Bank Height (m)	silt	Bank Angle (°)	20-60
Bank Material	silt	Vegetation	tall grasses, shrubs, trees
Pool - Riffle Spacing (m)	NA	Woody Debris	none
Channel Hardening			
Channel Disturbance	crushed fram culvert, black pvc pipe		
Distance Walked	all	Photos Taken	yes

Comments Lots of instream vegetation.

Date: 03-Jun-08

Site: VG-R3-1

Crew: JS

Location: Richmond, Ottawa

Weather Description: rain

Recorder: JS

FORM / PROCESS	GEOMORPHIC INDICATOR		PRESENT? (✓)		FACTOR VALUE
	Num	Description	No	Yes	
Evidence of Aggradation (AI)	1	Lobate Bar	X		
	2	Coarse materials in riffles embedded	X		
	3	Siltation in pools	X		
	4	Medial bars	X		
	5	Accretion on point bars	X		
	6	Poor longitudinal sorting of bed materials		X	
	7	Deposition in the overbank zone	X		
Sum of Indices:			6	1	0.14
Evidence of Degradation (DI)	1	Exposed bridge footing(s)	NA		
	2	Exposed sanitary / storm sewer / pipeline / etc.	NA		
	3	Elevated storm sewer outfall(s)	NA		
	4	Undermined gabion baskets / concrete aprons / etc.	NA		
	5	Scour pools d/s of culverts / storm sewer outlets	X		
	6	Cut face on bar forms	X		
	7	Head cutting due to knick point migration	X		
	8	Terrace cut through older bar material	X		
	9	Suspended armour layer visible in bank	X		
	10	Channel worn into undisturbed overburden / bedrock	X		
Sum of Indices:			6	0	0
Evidence of Widening (WI)	1	Fallen / leaning trees / fence posts / etc.		X	
	2	Occurrence of large organic debris		X	
	3	Exposed tree roots		X	
	4	Basal scour on inside meander bends	X		
	5	Basal scour on both sides of channel through riffle	X		
	6	Gabion baskets / concrete walls / etc. out flanked	NA		
	7	Length of basal scour >50% through subject reach	X		
	8	Exposed length of previously buried pipe / cable / etc.	NA		
	9	Fracture lines along top of bank	X		
	10	Exposed building foundation	NA		
Sum of Indices:			4	3	0.43
Evidence of Planimetric Form Adjustment (PI)	1	Formation of chute(s)	X		
	2	Single thread channel to multiple channel	X		
	3	Evolution of pool-riffle form to low bed relief form	X		
	4	Cut-off channel(s)	X		
	5	Formation of island(s)	X		
	6	Thalweg alignment out of phase meander form	X		
	7	Bar forms poorly formed / reworked / removed		X	
Sum of Indices:			6	1	0.14

COMMENTS:

STABILITY INDEX: 0.18

Condition: In Regime

~ Factor Value = # YES / Total #

~ STABILITY INDEX (SI) = (AI+DI+WI+PI)/4

SI ≤ 0.20 = In Regime

SI 0.21 - 0.40 = Transitional or Stressed

SI ≥ 0.41 = In Adjustment

Date: 03-Jun-08

Site: VG-R3-1

Crew: JS

Location:

Richmond, ON

Weather Description:

cloudy

Recorder:

JS

	<i>Excellent</i>	<i>Good</i>	<i>Fair</i>	<i>Poor</i>	<i>Points</i>
Channel Stability	9 - 11	6 - 8	3 - 5	0 - 2	4
Scour / Deposition	7 - 8	5 - 6	3 - 4	0 - 2	2
Instream Habitat	7 - 8	5 - 6	3 - 4	0 - 2	3
Water Quality	7 - 8	5 - 6	3 - 4	0 - 2	2
Riparian Conditions	6 - 7	4 - 5	2 - 3	0 - 2	4
Biological Indicators	7 - 8	5 - 6	3 - 4	0 - 2	3
Total:					18

Stability Rankings:

<20 = *LOW*

20 - 35 = *MODERATE*

>35 = *HIGH*

Channel Dimensions (Measured / Estimated)

Bankfull Width (m)	2.5, 3, 4	Bankfull Depth (m)	0.2, 0.35, 0.3
Wetted Width (m)	1.5-3.5	Wetted Depth (m)	0.15, 0.05
Gradient	low	Entrenchment (m)	low
Substrate (Pool)	NA	Substrate (Riffle)	silt/sand
Straight / Sinuous	straight	Bend Radius	NA
Bank Height (m)	0.4-0.6	Bank Angle (°)	15-40
Bank Material	silt/clay/sand	Vegetation	Trees, shrubs
Pool - Riffle Spacing (m)	NA	Woody Debris	major
Channel Hardening	none		
Channel Disturbance	small farm crossing culvert between fields		
Distance Walked	all	Photos Taken	yes

Comments high water levels due to recent rain, trees in channel.

Date: 03-Jun-08

Site: VG-R3-2

Crew: JS

Location: Richmond, Ottawa

Weather Description: rain

Recorder: JS

FORM / PROCESS	GEOMORPHIC INDICATOR		PRESENT? (✓)		FACTOR VALUE
	Num	Description	No	Yes	
Evidence of Aggradation (AI)	1	Lobate Bar	X		
	2	Coarse materials in riffles embedded	X		
	3	Siltation in pools	X		
	4	Medial bars	X		
	5	Accretion on point bars	X		
	6	Poor longitudinal sorting of bed materials		X	
	7	Deposition in the overbank zone	X		
Sum of Indices:			6	1	0.14
Evidence of Degradation (DI)	1	Exposed bridge footing(s)	NA		
	2	Exposed sanitary / storm sewer / pipeline / etc.	NA		
	3	Elevated storm sewer outfall(s)	NA		
	4	Undermined gabion baskets / concrete aprons / etc.	NA		
	5	Scour pools d/s of culverts / storm sewer outlets	X		
	6	Cut face on bar forms	X		
	7	Head cutting due to knick point migration	X		
	8	Terrace cut through older bar material	X		
	9	Suspended armour layer visible in bank	X		
	10	Channel worn into undisturbed overburden / bedrock	X		
Sum of Indices:			6	0	0
Evidence of Widening (WI)	1	Fallen / leaning trees / fence posts / etc.		X	
	2	Occurrence of large organic debris		X	
	3	Exposed tree roots		X	
	4	Basal scour on inside meander bends	X		
	5	Basal scour on both sides of channel through riffle	X		
	6	Gabion baskets / concrete walls / etc. out flanked	NA		
	7	Length of basal scour >50% through subject reach	X		
	8	Exposed length of previously buried pipe / cable / etc.	NA		
	9	Fracture lines along top of bank	X		
	10	Exposed building foundation	NA		
Sum of Indices:			4	3	0.43
Evidence of Planimetric Form Adjustment (PI)	1	Formation of chute(s)	X		
	2	Single thread channel to multiple channel	X		
	3	Evolution of pool-riffle form to low bed relief form	X		
	4	Cut-off channel(s)	X		
	5	Formation of island(s)	X		
	6	Thalweg alignment out of phase meander form	X		
	7	Bar forms poorly formed / reworked / removed		X	
Sum of Indices:			6	1	0.14

COMMENTS:

STABILITY INDEX: 0.18

Condition: In Regime

~ Factor Value = # YES / Total #

~ STABILITY INDEX (SI) = (AI+DI+WI+PI)/4

SI ≤ 0.20 = In Regime

SI 0.21 - 0.40 = Transitional or Stressed

SI ≥ 0.41 = In Adjustment

Date: 03-Jun-08

Site: VG-R3-2

Crew: JS

Location:

Richmond, ON

Weather Description:

cloudy, rain

Recorder:

JS

	<i>Excellent</i>	<i>Good</i>	<i>Fair</i>	<i>Poor</i>	<i>Points</i>
Channel Stability	9 - 11	6 - 8	3 - 5	0 - 2	5
Scour / Deposition	7 - 8	5 - 6	3 - 4	0 - 2	4
Instream Habitat	7 - 8	5 - 6	3 - 4	0 - 2	2
Water Quality	7 - 8	5 - 6	3 - 4	0 - 2	2
Riparian Conditions	6 - 7	4 - 5	2 - 3	0 - 2	3
Biological Indicators	7 - 8	5 - 6	3 - 4	0 - 2	3
Total:					19

Stability Rankings:

<20 = *LOW*

20 - 35 = *MODERATE*

>35 = *HIGH*

Channel Dimensions (Measured / Estimated)

Bankfull Width (m)	2.3-3.3	Bankfull Depth (m)	0.2, 0.25
Wetted Width (m)	0, 1, 1.5	Wetted Depth (m)	0, 0.05, 0.1
Gradient	very low	Entrenchment (m)	low
Substrate (Pool)	NA	Substrate (Riffle)	clay
Straight / Sinuous	straight	Bend Radius	NA
Bank Height (m)	0.70-0.8	Bank Angle (°)	5.0-35
Bank Material	clay/fine sand, very fine sand	Vegetation	Trees, shrubs
Pool - Riffle Spacing (m)	NA	Woody Debris	major
Channel Hardening	none		
Channel Disturbance	small farm crossing culvert between fields		
Distance Walked	all	Photos Taken	yes

Comments tree lined ditch between crop fields.

Date: 03-Jun-08

Site: JED1

Crew: JS

Location: Richmond, Ottawa

Weather Description: rain

Recorder: JS

FORM / PROCESS	GEOMORPHIC INDICATOR		PRESENT? (✓)		FACTOR VALUE
	Num	Description	No	Yes	
Evidence of Aggradation (AI)	1	Lobate Bar	X		
	2	Coarse materials in riffles embedded		X	
	3	Siltation in pools		X	
	4	Medial bars	X		
	5	Accretion on point bars	X		
	6	Poor longitudinal sorting of bed materials		X	
	7	Deposition in the overbank zone	X		
Sum of Indices:			4	3	0.43

Evidence of Degradation (DI)	1	Exposed bridge footing(s)	NA		
	2	Exposed sanitary / storm sewer / pipeline / etc.	NA		
	3	Elevated storm sewer outfall(s)	NA		
	4	Undermined gabion baskets / concrete aprons / etc.	NA		
	5	Scour pools d/s of culverts / storm sewer outlets	NA		
	6	Cut face on bar forms	X		
	7	Head cutting due to knick point migration	X		
	8	Terrace cut through older bar material	X		
	9	Suspended armour layer visible in bank	X		
	10	Channel worn into undisturbed overburden / bedrock	X		
Sum of Indices:			5	0	0

Evidence of Widening (WI)	1	Fallen / leaning trees / fence posts / etc.	X		
	2	Occurrence of large organic debris	X		
	3	Exposed tree roots	X		
	4	Basal scour on inside meander bends	X		
	5	Basal scour on both sides of channel through riffle	X		
	6	Gabion baskets / concrete walls / etc. out flanked	NA		
	7	Length of basal scour >50% through subject reach	X		
	8	Exposed length of previously buried pipe / cable / etc.	NA		
	9	Fracture lines along top of bank	X		
	10	Exposed building foundation	NA		
Sum of Indices:			7	0	0

Evidence of Planimetric Form Adjustment (PI)	1	Formation of chute(s)	X		
	2	Single thread channel to multiple channel	X		
	3	Evolution of pool-riffle form to low bed relief form	X		
	4	Cut-off channel(s)	X		
	5	Formation of island(s)		X	
	6	Thalweg alignment out of phase meander form	X		
	7	Bar forms poorly formed / reworked / removed		X	
Sum of Indices:			6	1	0.29

COMMENTS:
STABILITY INDEX: 0.18

Condition: In Regime

~ Factor Value = # YES / Total #

~ STABILITY INDEX (SI) = (AI+DI+WI+PI)/4

SI ≤ 0.20 = In Regime

SI 0.21 - 0.40 = Transitional or Stressed

Date: 03-Jun-08

Site: JED1

Crew: JS

Location:

Richmond, ON

Weather Description:

cloudy, rain

Recorder:

JS

	<i>Excellent</i>	<i>Good</i>	<i>Fair</i>	<i>Poor</i>	<i>Points</i>
Channel Stability	9 - 11	6 - 8	3 - 5	0 - 2	5
Scour / Deposition	7 - 8	5 - 6	3 - 4	0 - 2	2
Instream Habitat	7 - 8	5 - 6	3 - 4	0 - 2	2
Water Quality	7 - 8	5 - 6	3 - 4	0 - 2	2
Riparian Conditions	6 - 7	4 - 5	2 - 3	0 - 2	3
Biological Indicators	7 - 8	5 - 6	3 - 4	0 - 2	3
Total:					17

Stability Rankings:

<20 = *LOW*

20 - 35 = *MODERATE*

>35 = *HIGH*

Channel Dimensions (Measured / Estimated)

Bankfull Width (m)	2-3	Bankfull Depth (m)	0.4-0.7
Wetted Width (m)	1-1.5	Wetted Depth (m)	0.1-0.3
Gradient	low	Entrenchment (m)	low
Substrate (Pool)	NA	Substrate (Riffle)	silt/clay/fine sands
Straight / Sinuous	straight	Bend Radius	NA
Bank Height (m)	1m	Bank Angle (°)	15-40
Bank Material	silt/clay	Vegetation	tall grass, herbs
Pool - Riffle Spacing (m)	NA	Woody Debris	none
Channel Hardening	none		
Channel Disturbance	ATV crossing/old wooden crossing		
Distance Walked	200 m	Photos Taken	yes

Comments Very straight swale - uniform channel. Lots of instream vegetation in clumps.

RAPID GEOMORPHIC ASSESSMENT (RGA)

Date: 03-Jun-08

Site: JED3

Crew: JS

Location: Richmond, Ottawa

Weather Description: rain

Recorder: JS

FORM / PROCESS	GEOMORPHIC INDICATOR		PRESENT? (✓)		FACTOR VALUE
	Num	Description	No	Yes	
Evidence of Aggradation (AI)	1	Lobate Bar	X		
	2	Coarse materials in riffles embedded		X	
	3	Siltation in pools		X	
	4	Medial bars	X		
	5	Accretion on point bars	X		
	6	Poor longitudinal sorting of bed materials	X		
	7	Deposition in the overbank zone	X		
Sum of Indices:			5	2	0.29
Evidence of Degradation (DI)	1	Exposed bridge footing(s)	NA		
	2	Exposed sanitary / storm sewer / pipeline / etc.	NA		
	3	Elevated storm sewer outfall(s)	NA		
	4	Undermined gabion baskets / concrete aprons / etc.	NA		
	5	Scour pools d/s of culverts / storm sewer outlets	NA		
	6	Cut face on bar forms	X		
	7	Head cutting due to knick point migration	X		
	8	Terrace cut through older bar material	X		
	9	Suspended armour layer visible in bank	X		
	10	Channel worn into undisturbed overburden / bedrock	X		
Sum of Indices:			5	0	0
Evidence of Widening (WI)	1	Fallen / leaning trees / fence posts / etc.	X		
	2	Occurrence of large organic debris	X		
	3	Exposed tree roots	X		
	4	Basal scour on inside meander bends	X		
	5	Basal scour on both sides of channel through riffle	X		
	6	Gabion baskets / concrete walls / etc. out flanked	NA		
	7	Length of basal scour >50% through subject reach	X		
	8	Exposed length of previously buried pipe / cable / etc.	NA		
	9	Fracture lines along top of bank	X		
	10	Exposed building foundation	NA		
Sum of Indices:			7	0	0
Evidence of Planimetric Form Adjustment (PI)	1	Formation of chute(s)	X		
	2	Single thread channel to multiple channel	X		
	3	Evolution of pool-riffle form to low bed relief form	X		
	4	Cut-off channel(s)	X		
	5	Formation of island(s)	X		
	6	Thalweg alignment out of phase meander form	X		
	7	Bar forms poorly formed / reworked / removed		X	
Sum of Indices:			6	1	0.14

COMMENTS:
STABILITY INDEX: 0.11

Condition: In Regime

~ Factor Value = # YES / Total #

~ STABILITY INDEX (SI) = (AI+DI+WI+PI)/4

SI ≤ 0.20 = In Regime

SI 0.21 - 0.40 = Transitional or Stressed

Date: 03-Jun-08

Site: JED3

Crew: JS

Location:

Richmond, ON

Weather Description:

cloudy, rain

Recorder:

JS

	<i>Excellent</i>	<i>Good</i>	<i>Fair</i>	<i>Poor</i>	<i>Points</i>
Channel Stability	9 - 11	6 - 8	3 - 5	0 - 2	4
Scour / Deposition	7 - 8	5 - 6	3 - 4	0 - 2	2
Instream Habitat	7 - 8	5 - 6	3 - 4	0 - 2	2
Water Quality	7 - 8	5 - 6	3 - 4	0 - 2	2
Riparian Conditions	6 - 7	4 - 5	2 - 3	0 - 2	3
Biological Indicators	7 - 8	5 - 6	3 - 4	0 - 2	2
Total:					15

Stability Rankings:

<20 = *LOW*

20 - 35 = *MODERATE*

>35 = *HIGH*

Channel Dimensions (Measured / Estimated)

Bankfull Width (m)	<u>2-3</u>	Bankfull Depth (m)	<u>0.3-0.5</u>
Wetted Width (m)	<u>1.0-2.0</u>	Wetted Depth (m)	<u>0.1-0.3</u>
Gradient	<u>low</u>	Entrenchment (m)	<u>low</u>
Substrate (Pool)	<u></u>	Substrate (Riffle)	<u>silts/fine sands/organics</u>
Straight / Sinuous	<u>straight</u>	Bend Radius	<u>NA</u>
Bank Height (m)	<u>0.4-0.8</u>	Bank Angle (°)	<u>15-40</u>
Bank Material	<u>silt</u>	Vegetation	<u>tall grass, herbs</u>
Pool - Riffle Spacing (m)	<u>NA</u>	Woody Debris	<u>minor</u>
Channel Hardening	<u></u>		<u>none</u>
Channel Disturbance	<u></u>		<u>none</u>
Distance Walked	<u>all</u>	Photos Taken	<u>yes</u>

Comments swale channel - lots of instream vegetation.

FLUVIAL GEOMORPHOLOGY SUMMARY

Richmond VG-R2

Site Location: South West of Mira Crescent, started approx 30-40m US from Perth St
Length surveyed: 172.84 m
Number of cross-sections: 5
Date of Survey: 10-Jun-08

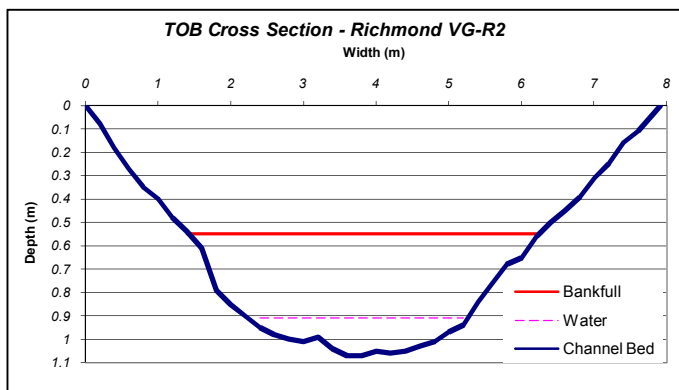
Modifying Factors

Surrounding Land Use: Corn fields on either side of reach
General Riparian Vegetation: Tall Grasses & Herbs for approx 5m on both sides of channel
Existing Channel Disturbances: None within the survey

Woody Debris: minor

Cross-Sectional Characteristics

	Range	Average
Bankfull Width (m)	4.50 - 5.49	4.99
Bankfull Depth (m)	0.38 - 0.43	0.39
Width / Depth	11.75 - 13.73	12.70
Wetted Width (m)	2.71 - 3.04	2.86
Water Depth (m)	0.09 - 0.15	0.12
Width / Depth	18.46 - 31.27	24.24
Entrenchment (m)	9.80 - 13.50	11.86
Entrenchment Ratio	2.04 - 3.00	2.40



Bank Characteristics

	Range	Average
Bank Height (m)	1.5 - 1.5	1.5
Bank Angle (degrees)	17 - 38	25.7
Root Depth (cm)	12.0 - 15	13.2
Root Density (1=Low - 5=High)	2 - 2	2.0
Protected by vegetation (%)	65 - 75	69.5
Amount of undercut (cm)	0.0 - 0	0.00000
Banks with undercuts (%)		0%

Bank Materials	Torvane values (kg/cm2)
Cl *	0.42
Cl/Vfs	0.42
Cl/Fs/Vfs	0.43
Cl/Fs	0.41

* - Dominant Material

FLUVIAL GEOMORPHOLOGY SUMMARY

Richmond VG-R2

Planform Characteristics

Long Profile (avg)

Bankfull Gradient: 0.15 %

Substrate Characteristics

Particle Shape (cm)		Range	Average
X		5 - 5	5.0
Y		4 - 4	4.0
Z		3 - 3	3.0

Hydraulic Roughness (cm)

Maximum	0 - 0	#DIV/0!
Median	0 - 0	#DIV/0!
Minimum	0 - 0	#DIV/0!

Embeddedness (%)

Sub-pavement	0 - 0	0.0
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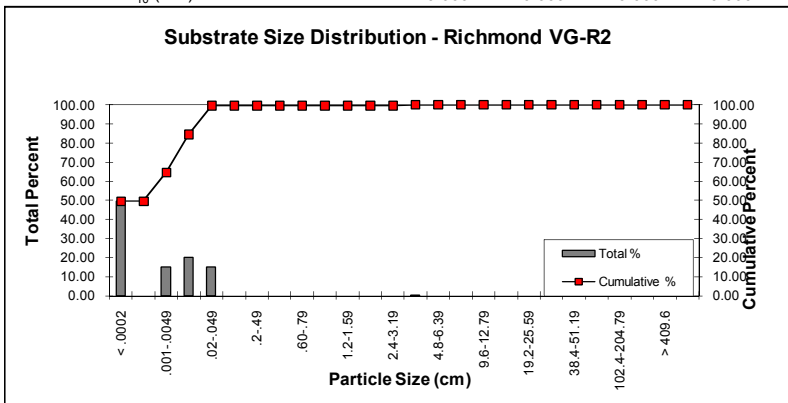
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si	0	1cm	0
vfs	0	1.5cm	0
fs	0	2cm	0
ms	0	3cm	0
cs	0	4cm	0
vcs	0	5cm	0
		Bdr.	0

Particle Sizes (cm)

Pebble Counts

D10	0.0002 mm
D50	0.002 mm
D90	0.150 mm

D ₉₅ (mm):	0.020	0.255	0.300	0.255
D ₉₀ (mm):	0.010	0.165	0.255	0.165
D ₈₄ (mm):	0.005	0.023	0.201	0.095
D ₆₅ (mm):	0.001	0.002	0.084	0.010
D ₅₀ (mm):	0.001	0.001	0.006	0.001
D ₁₆ (mm):	0.000	0.000	0.000	0.000
D ₁₀ (mm):	0.000	0.000	0.000	0.000



Field Observations

XS-1 - Outfall along RB 6-8m US of cross section
 high amount of minnows in channel
 odd well system along LB 6-8m US (see photo)
 Agricultural Fields beyond both banks (corn)
 XS-2 - Well along LB 4m DS of Cross section
 Little or no particles in substrate (all clay)
 veg in channel along LB
 GPS Coordinates - 0433364, 5004418
 Erosion Pins - RB 4m US, 22.5cm. LB @ XS, 20cm
 Well vegetated banks on both banks

FLUVIAL GEOMORPHOLOGY SUMMARY

Richmond VG-R2

small amount of veg in channel along LB

XS-3 - Site remains constant with DS section, (bank heights, wetted widths, etc)
meander bend 10m US of XS

XS-4 - Aquatic veg growing in channel

XS-5 - Aquatic veg growing in channel

Site features very consistent throughout reach, not many comments

FLUVIAL GEOMORPHOLOGY SUMMARY

Richmond - VG-R3

Site Location: Town of Richmond, East of Fortune St, First field break east of road
Length surveyed: 128.86 m
Number of cross-sections: 5
Date of Survey: June 13/2008

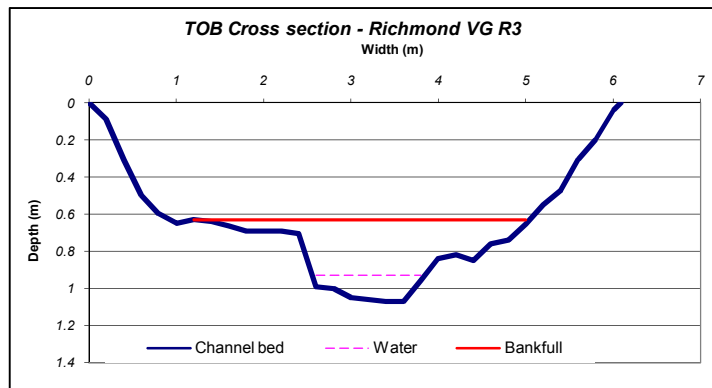
Modifying Factors

Surrounding Land Use: Natural along RB, Agri (corn) along LB
General Riparian Vegetation: Channel is overgrown with natural grasses & herbs, both banks well vegetated with tall grasses & herbs, along Right bank Hawthorne is very prevalent along with other small shrubs
Existing Channel Disturbances: None, Channel has likely been ditched previously

Woody Debris: minor

Cross-Sectional Characteristics

	Range	Average
Bankfull Width (m)	4.00 - 4.65	4.28
Bankfull Depth (m)	0.23 - 0.35	0.29
Width / Depth	11.41 - 18.38	15.35
Wetted Width (m)	1.31 - 2.52	1.89
Water Depth (m)	0.07 - 0.09	0.09
Width / Depth	14.00 - 36.20	23.38
Entrenchment (m)	9.15 - 104.20	42.12
Entrenchment Ratio	1.97 - 24.81	10.01



Bank Characteristics

	Range	Average
Bank Height (m)	1.5 - 2.5	1.895
Bank Angle (degrees)	22 - 51	34.7
Root Depth (cm)	9.0 - 21	15.0
Root Density (1=Low - 5=High)	1 - 3	2.0
Protected by vegetation (%)	17 - 75	58.2
Amount of undercut (cm)	0.0 - 0	0.00000
Banks with undercuts (%)		0%

Bank Materials	Torvane values (kg/cm2)
Cl *	0.42
Cl/Fs/Vfs	0.21
Cl/Vfs	0.48
Cl/Fs	0.36
Si/Fs	0.30

* - Dominant Material

FLUVIAL GEOMORPHOLOGY SUMMARY

Richmond - VG-R3

Planform Characteristics

Long Profile (avg)

Bankfull Gradient: 0.83 %

Substrate Characteristics

Particle Shape (cm)		Range	Average
X		0 - 0	0.0
Y		0 - 0	0.0
Z		0 - 0	0.0

Hydraulic Roughness (cm)

Maximum	0 - 0	0.0
Median	0 - 0	0.0
Minimum	0 - 0	0.0

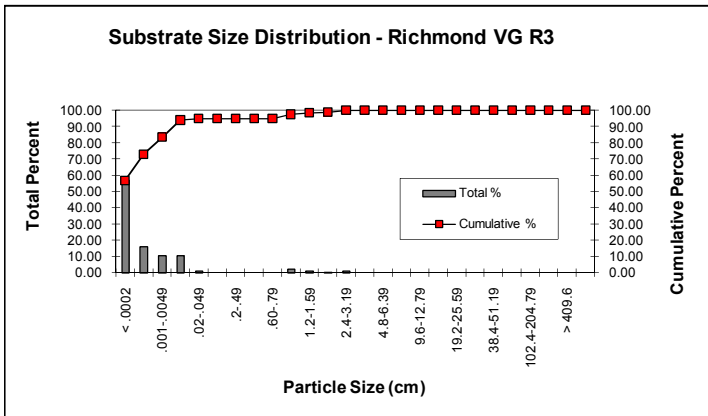
Embeddedness (%)

Sub-pavement	0 - 0	0.0
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cl	100	P	0
si	0	1cm	0
vfs	0	1.5cm	0
fs	0	2cm	0
ms	0	3cm	0
cs	0	4cm	0
vcs	0	5cm	0
		Bdr.	0

Particle Sizes (cm)

	Pebble Counts		Grain Size Analysis	
D10	3.1500	mm	Not Sampled	
D50	0.0110	mm		
D90	0.0002	mm		
	XS1	XS2	XS3	XS4 XS5
D ₉₀ (mm):	0.04760	0.04760	12.5	0.0476
D ₈₄ (mm):	0.02278	0.02278	9.286	0.02278
D ₆₅ (mm):	0.00190	0.00190	0.05966667	0.0043
D ₅₀ (mm):	0.00080	0.00080	0	0.0025
D ₁₆ (mm):	0.00026	0.00026	0.00032	0.000427
D ₁₀ (mm):	0.00016	0.00016	0.0002	0.000267



Field Observations

XS1 - Soft unconsolidated substrate

Lots of tall emergent grasses/reeds growing in channel

Very little flow, water is murky

No rocks in subs, all fine materials

XS2 - Heavy vegetation along both banks & in channel

Erosion Pins - LB @ XS - 16.5cm, LB 5m DS - 21cm

XS3 - Same conditions as XS 1&2, heavy veg, low flow

XS4 - Heavy veg, low flow, wetted edge approx 5-7m from edge of field

XS5 - XS is in forested area, much different than previous 4m, much less ground veg, more exposed soil

FLUVIAL GEOMORPHOLOGY SUMMARY

Richmond - VG-R3-2

Site Location: Town of Richmond, East of Fortune St, Field Break Running E-W
Length surveyed: 67.17 m
Number of cross-sections: 5
Date of Survey: June 13/2008

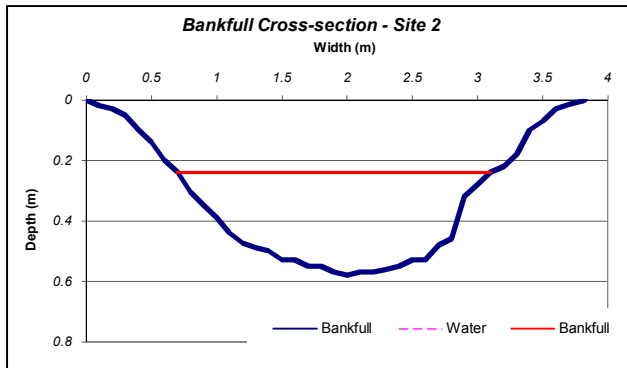
Modifying Factors

Surrounding Land Use: Agricultural Fields on either side of channel, channel is heavily vegetated with mature trees growing right in channel & along banks, some herbs and shrubs are prevalent as well
General Riparian Vegetation: Mature trees and some small shrubs
Existing Channel Disturbances: None

Woody Debris: Minor throughout in channel & along banks, debris jams approx every 20m

Cross-Sectional Characteristics

	Range	Average
Bankfull Width (m)	2.30 - 3.28	2.80
Bankfull Depth (m)	0.21 - 0.26	0.24
Width / Depth	9.26 - 13.03	11.57
Wetted Width (m)	0.80 - 1.40	1.10
Water Depth (m)	0.03 - 0.04	0.04
Width / Depth	23.70 - 31.93	27.82
Entrenchment (m)	102.30 - 103.28	102.80
Entrenchment Ratio	31.49 - 44.48	37.37
Manning's n		0.33



Bank Characteristics

	Range	Average
Bank Height (m)	0.75 - 0.8	0.755
Bank Angle (degrees)	5 - 35	23.5
Root Depth (cm)	9.0 - 21	15.3
Root Density (1=Low - 5=High)	2 - 2	2.0
Protected by vegetation (%)	40 - 60	51.0
Amount of undercut (cm)	0.0 - 0	
Banks with undercuts (%)		

Bank Materials	Torvane values (kg/cm2)
Cl *	0.40
Cl/Fs/Vfs	0.23

* - Dominant Material

FLUVIAL GEOMORPHOLOGY SUMMARY

Richmond - VG-R3-2

Planform Characteristics

Long Profile (avg)

Bankfull Gradient: 0.46 %

Substrate Characteristics

Particle Shape (cm)		Range	Average
X		0 - 0	0.0
Y		0 - 0	0.0
Z		0 - 0	0.0

Hydraulic Roughness (cm)

Maximum	0 - 0	0.0
Median	0 - 0	0.0
Minimum	0 - 0	0.0

Embeddedness (%)

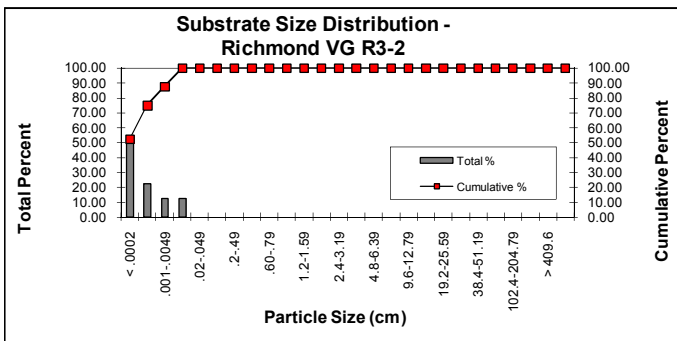
Sub-pavement	0 - 0	0.0
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cl	100	P	0
si	0	1cm	0
vfs	0	1.5cm	0
fs	0	2cm	0
ms	0	3cm	0
cs	0	4cm	0
vcs	0	5cm	0
		Bdr.	0

Particle Sizes (cm)

	Pebble Counts	Grain Size Analysis
D10	0.0002 mm	
D50	0.0010 mm	
D90	0.0500 mm	

	XS1	XS2	XS3	XS4	XS5
D90 (mm):	0.047600	0.047600	0.047600	0.047600	
D84 (mm):	0.022780	0.022780	0.022780	0.022780	
D65 (mm):	0.003700	0.003700	0.003700	0.003700	
D50 (mm):	0.001000	0.001000	0.001000	0.001000	
D16 (mm):	0.000320	0.000320	0.000320	0.000320	
D10 (mm):	0.000200	0.000200	0.000200	0.000200	



Field Observations

XS1 - Located in one of the few areas with water in channel
 Wood debris in channel both US & DS of XS
 Mature trees in channel (growing)
 XS2 - Difficult to pin banks due to lack of water in channel
 Major debris in channel, mature trees growing in channel
 TOB XS GPS - 0433943
 Erosion Pins - RB @ XS - 25.5cm, LB 4m DS - 30cm
 XS3 - No water
 Mature trees in channel and along banks
 XS4 - Reach is dry, heavily wooded, very thick
 XS5 - SEE XS 1-4

FLUVIAL GEOMORPHOLOGY SUMMARY

Richmond JED-1

Site Location: Richmond Ontario, South of Ottawa St, Middle of Large Idle field,
Length surveyed: 98.39 m
Number of cross-sections: 5
Date of Survey: 13-Jun-08

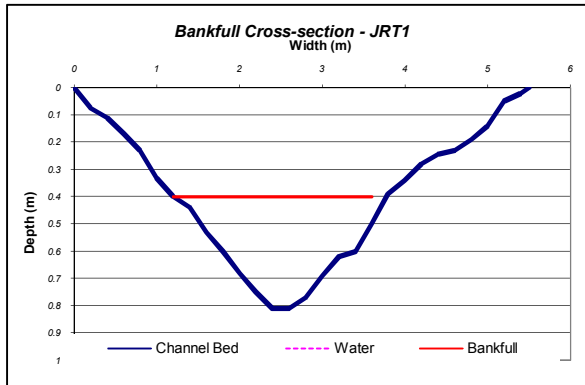
Modifying Factors

Surrounding Land Use: Idle Fields on either side
General Riparian Vegetation: No mature trees or shrubs, lots of tall and short herbs and grasses on banks as well as in channel
Existing Channel Disturbances: Likely ditched

Woody Debris: None

Cross-Sectional Characteristics

	Range	Average
Bankfull Width (m)	2.24 - 2.85	2.45
Bankfull Depth (m)	0.21 - 0.24	0.23
Width / Depth	0.00 - 13.64	8.67
Wetted Width (m)	0.63 - 1.09	0.87
Water Depth (m)	0.05 - 0.08	0.06
Width / Depth	0.00 - 14.62	10.12
Entrenchment (m)	5.74 - 102.40	30.20
Entrenchment Ratio	2.40 - 42.67	10.03
Manning's n		0.04



Bank Characteristics

	Range	Average
Bank Height (m)	0.75 - 0.75	0.75
Bank Angle (degrees)	12 - 27	21.4
Root Depth (cm)	10.0 - 14	12.4
Root Density (1=Low - 5=High)	2 - 2	2.0
Protected by vegetation (%)	50 - 60	53.5
Amount of undercut (cm)	0.0 - 0	0.00000
Banks with undercuts (%)	0	0%

Bank Materials	Torvane values (kg/cm2)
Cl/Fs *	0.31
Cl/Vfs	0.33
Cl	0.28
Cl/Vfs/Fs	0.31

* - Dominant Material

FLUVIAL GEOMORPHOLOGY SUMMARY

Richmond JED-1

Planform Characteristics

Long Profile (avg)

Bankfull Gradient: 0.13 %

Substrate Characteristics

Particle Shape (cm)		Range	Average
X		0 - 0	0.0
Y		0 - 0	0.0
Z		0 - 0	0.0

Hydraulic Roughness (cm)

Maximum	0 - 0	0.0
Median	0 - 0	0.0
Minimum	0 - 0	0.0

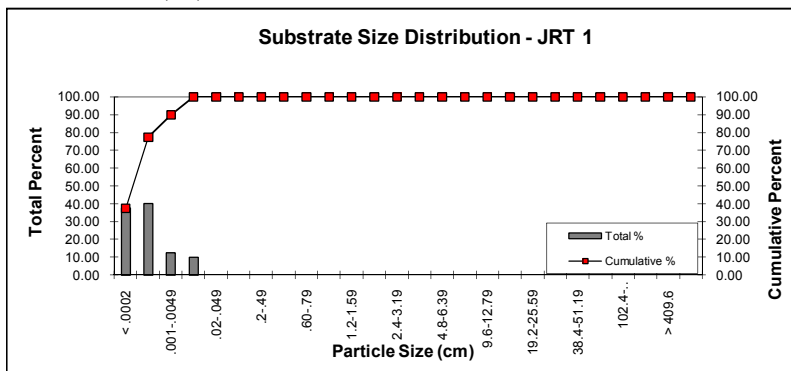
Embeddedness (%)

Sub-pavement	0 - 0	0.0
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cl	100	P	0
si	0	1cm	0
vfs	0	1.5cm	0
fs	0	2cm	0
ms	0	3cm	0
cs	0	4cm	0
vcs	0	5cm	0
		Bdr.	0

Particle Sizes (mm)

	Pebble Counts		Grain Size Analysis				
D10	0.0003	mm					
D50	0.00	mm					
D90	1.56	mm					
	XS1	XS2	XS3	XS4	XS5		
D90 (mm):	0.0476	7.662857	0.0103	0.0476	0.0476		
D84 (mm):	0.0228	0.09466	0.00508	0.02278	0.02278		
D65 (mm):	0.0046	0.0043	0.0028	0.0043	0.0043		
D50 (mm):	0.0032	0.0025	0	0.0025	0.0025		
D16 (mm):	0.0006	0.000427	0.00032	0.000427	0.0004267		
D10 (mm):	0.0004	0.000267	0.0002	0.000267	0.0002667		



Field Observations

XS1 - TOB - GPS Coordinates - 0434161, 5002959

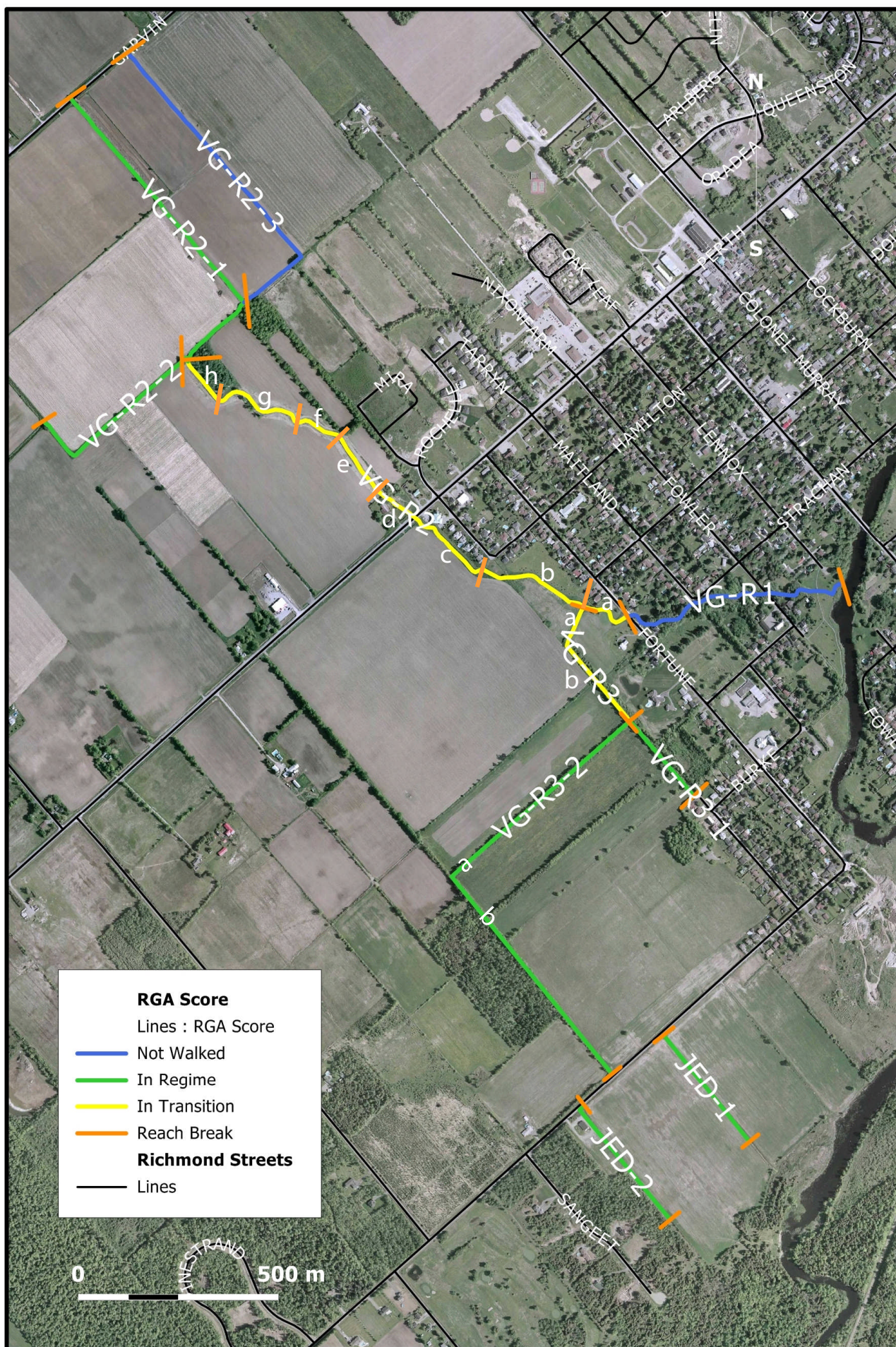
Erosion Pins - RB 5m US - 30cm, RB @ XS - 30cm

XS4 - Low flow, lots of veg on banks, Veg growing in channel

XS5 - Reach is basically a drainage channel between two Agri fields (idle)

Channel is heavily vegetated with tall grasses on both banks

Little or no particles in substrate (all clay)



Summary of Reach Data

Reach	Sub-Reach	Gradient	Run	Pool	Riffle	Flats	Culvert	Depth (m)				Width (m)				Substrate		Length (m)
								Bankfull	Late Spring	Summer	Fall	Bankfull	Late Spring	Summer	Fall	Pools	Riffles	
VG-R1	all	Low																601
VG-R2	all	Low	85	5	10			0.6-1.5	0.2-1			4.0-10	3.5-7			sand	sand, gravel	1407
	a		100								0.5				3.2	silt, sand, clay		126
	b		100							0.4	0.3-0.4			2.7	1.8	silt, sand, clay		289
	c		90	10						0.4	0.2-0.3			3.4	2.9	silt, sand, clay		229
	d		100							0.2-0.4	0.2-0.3				1.8	silt, sand, clay		118
	e		100							0.3	0.25			4.2	2.9	silt, sand on clay		170
	f		80		20					0.2	0.15-0.2			4.4	3.1	sand, silt on clay	boulder, cobble	109
	g		90	5	5					0.2-0.4	0.15-0.2				2.6	silt, sand, clay	gravel, cobble	230
	h		90		10					0.2-0.3	0.1-0.15			2.4-4.6	4	clay, silt	boulder, cobble	135
VG-R2-1	all	Low-Moderate	100					0.6-1.0	0.15-0.4			4-4.5	2.0-4			sand, silt, clay		884
	a																	677
	b		100							0.1-0.3	0.05		2.0-3	1.0-2	1.4	muck, clay		207
VG-R2-2	all	Low	95	4	1			0.7-1.2	0.5-0.6	0.3-1.0	1.14	2.0-4.0	1.5-2	1.5-3	2.3	clay, silt		494
VG-R3	all	Low	100					0.6-1.0	0.15-0.6	0.05-0.10	0.05-0.10	4.0-7	2.0-4	0.25-0.50	0.25-0.50	silt, sand, clay, gravel		352
	a		99				1			0.05 - 0.10	0.05 - 0.10				0.4	clay, sand		111
	b		100							0.02-0.05	0.02-0.05				1.4	clay, sand		241
VG-R3-1	all	Low	100					0.2-0.35	0.05-0.15	Dry	Dry	2.5-4	1.5-3.5	Dry	Dry	clay, sand, silt		247
VG-R3-2	all	Very Low	100					0.2-0.25	0-0.1			2.3-3.3	0-1.5			clay, detritus		1228
	a		99				1			0-0.05	Dry			0-1.5	Dry	clay, detritus		593
	b		100							0.05-0.10	Dry			1-1.5	Dry	clay, detritus		635
JED-1	all	Low	100					0.4-0.7	1.0-2	0.25-0.50	Dry	2-3.5	0.1-0.3	0.5-1.0	Dry	clay, sand, silt		343
JED-2	all	Low	100					0.5-0.6	1.5-3	0.05-0.10	Dry	2-3.5	0.2-0.3	0-0.4	Dry	clay, sand, silt		370

To: Bruce Kilgour, Kilgour & Associates Ltd.
Date: 29 January, 2010

From: Benjamin C. Wilkins, M.Sc. and John Parish, P.Geo.
Project: 03.08.02

Subject: Refined meander belt width for Richmond Lands, Reach VG-R3-1 and VG-R3-2

INTRODUCTION

As part of the existing conditions report for the Mattamy Richmond Lands prepared by Kilgour & Associates Ltd. in 2008, PARISH Geomorphic Ltd. was retained to perform a broad geomorphic assessment of the site. These initial assessments of meander belt width were determined using aerial photograph analysis. It has since been requested that PARISH perform an additional in-depth survey of reaches VG-R3-1 and VG-R3-2 (**Figure 1**), in order to make possible the refinement of meander belt width calculations particular to these sites. To this end, PARISH has undertaken a field investigation of the reaches in question, collected the necessary data, and completed further, more refined, calculations of meander belt width.

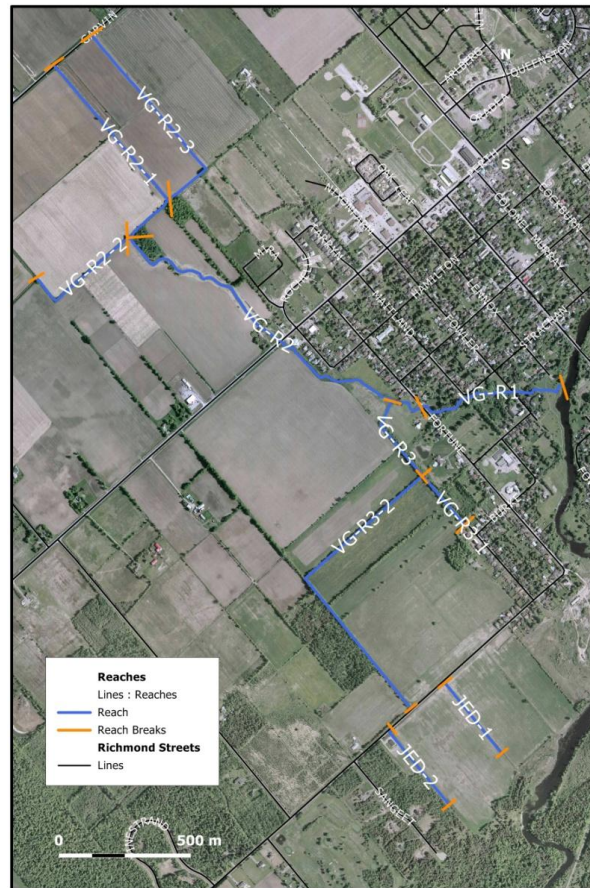


Figure 1. Watercourse reach delineation on Mattamy Richmond Lands.

INITIAL MEANDER BELT WIDTH ASSESSMENT

The initial assessment of meander belt widths determined for Mattamy Richmond Lands was performed using aerial photograph analysis. The results of this study are presented in Kilgour & Associates Ltd., 2008. Historic aerial photographs of the reaches, dating back to 1946 were used where possible. Many of the reaches had been straightened prior to 1946, including VG-R3-1 and VG-R3-2. As such, direct analysis of aerial photographs was not possible and surrogate reaches were used where feasible. No adequate surrogates were found for the 1st and 2nd order watercourses within the Mattamy Richmond Lands study area, which includes reach VG-R3-1 (1st order) and VG R3-2 (2nd order). However, surrogate reaches were identified for the 1st and 2nd order reaches within the Jock River Reach 2 Subwatershed in a similar geologic setting to the reaches on Mattamy Richmond Lands. Using this information, all 1st order reaches were assigned a meander belt width of 25 m, while 2nd order reaches were assigned a meander belt width of 30 m.

REFINED MEANDER BELT WIDTH ASSESSMENT

In order to refine the meander belt widths for reaches VG-R3-1 and VG-R3-2, a field survey was conducted at these reaches on December 8th, 2009 (cross sections for the six sites are shown in Appendix I). From this survey, the bankfull width of reach VG-R3-1 was determined to be 3.2 m, and bankfull depth 0.28 m. Bankfull width of VG-R3-2 was determined to average 3.0 m and bankfull depth 0.25 m. Bankfull discharge is approximately 0.5 m³/s in both reaches. Using the field data and meander geometry equations detailed in FISRWG, 2001, we calculated a meander belt width of 19 m for reach VG-R3-1, and 18 m for VG-R3-2 (**Table 1**). The calculated widths include a 20% factor of safety to account for future land-use change leading to hydrologic flow-regime alteration, and natural increases in channel migration. This factor of safety is a standard protocol as detailed in PARISH, 2004, and is applied to all calculations of this nature

Table 1. Summary of pertinent field data and meander belt widths.

	Reach VG-R3-1	Reach VG-R3-2
Bankfull width (m)	3.2	3.0
Bankfull depth (m)	0.28	0.25
Meander Belt Width (m)	19	18

The meander belt width values listed in **Table 1** are based on the current form and function of the channel. These values should only be applied to the reaches in their present conditions. Should post-development conditions change the flow regime currently in place, possibly by routing storm-water runoff more quickly to the channel, or increasing the flow regime in any other way, it will be necessary to reassess the reaches in question. It is our understanding that the North-South section of reach VG-R3-2 is to be designed to convey a 100 year flow of 1.5 m³/s, while the East-West section will be constructed to convey 4.8 m³/s for the same 100 year event. This discrepancy in planned flow is indicative that flow regime will be altered, specifically for the E-W section of the reach. If this is the case, and a natural channel design is

to be put in place, the meander belt width will need to be recalculated in keeping with the planned increase in flow through the channel.

Because these calculations are based on additional data, the meander belt widths can be taken in confidence as refined values of the previously determined meander belt widths for reaches VG-R3-1 and VG-R3-2. The refined values were determined by a reach specific study and are not applicable to other reaches in the Mattamy Richmond Lands study area.

Sincerely,



Benjamin C. Wilkins
<digitally signed>



John Parish
<digitally signed>

REFERENCES

FISRWG, 2001. Stream Corridor Restoration: Principles, Processes, and Practices. By the Federal Interagency Stream Restoration Working Group (FISRWG)(15 Federal agencies of the US gov't). GPO Item No. 0120-A; SuDocs No. A 57.6/2:EN 3/PT.653. ISBN-0-934213-59-3.

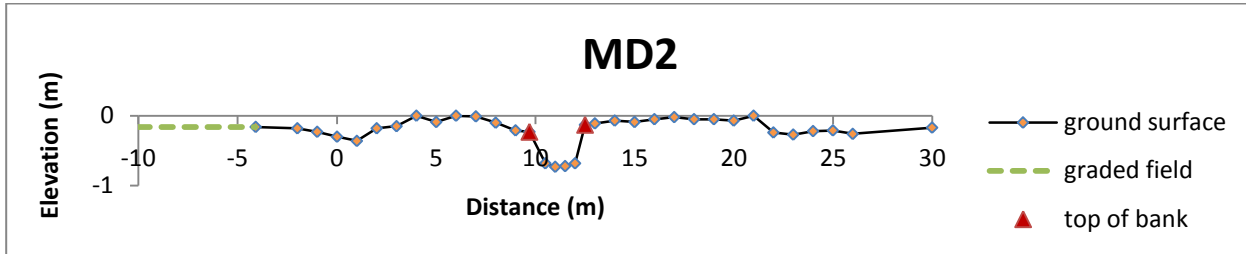
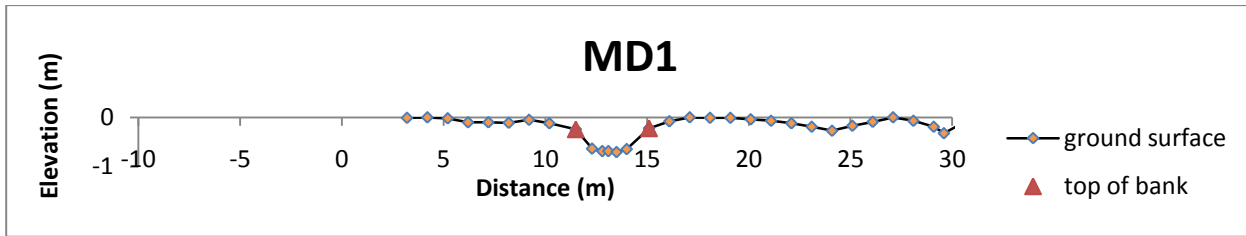
Kilgour & Associates, 2008. Natural Environment Existing Conditions, Mattamy Richmond Lands.

PARISH Geomorphic Ltd., 2004. Belt Width Delineation Procedures. Submitted to Toronto and Region Conservation Authority.

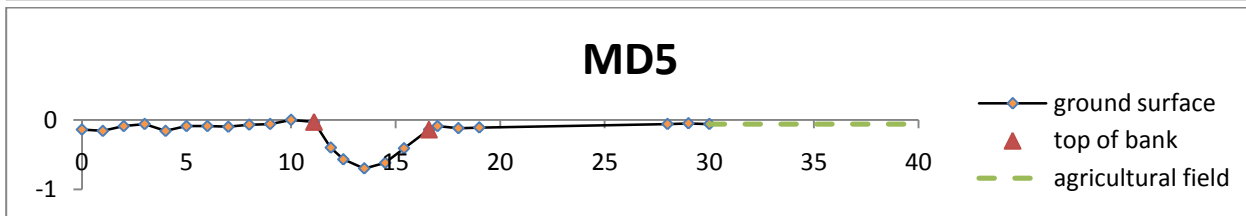
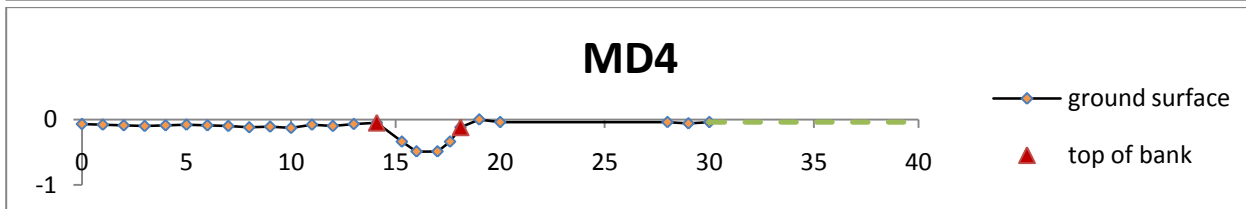
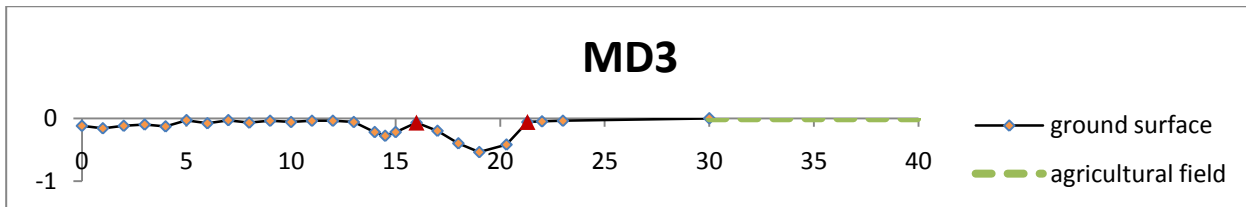
- APPENDIX I -

FIELD SURVEY CROSS SECTIONS

Reach VG-R3-1



Reach VG-R3-2 (North-South section)



Reach VG-R3-2 (East-West section)

